# §11. H-mode-Like Discharges and ELM-Like Activities under the Presence of ι/2π=1 at Ergodic Layer in LHD

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Shifting the $R_{ax}$ outwardly, the profile of rotational transform becomes flat and the edge rotational transform at ρ=1, ι/2π(a), becomes small with decreasing the edge magnetic shear (see Fig.1). Then, the values of ι/2π(a) are below unity at $R_{ax}$≥3.90m. The H-mode-like discharge with ELM-like activity has been observed in LHD at outwardly shifted configuration where ι/2π=1 exists inside the edge ergodic layer.

A typical waveform of the H-mode-like discharge is shown in Fig.2. The H-mode-like transition is triggered by changing the NBI power input at t=1.25s. After turning off the beam line, the Hα emission quickly drops and the density gradually rises, showing a clear turning point. ELM-like bursts appear in the Hα signal. Similar bursts are also observed in an electrostatic probe on the divertor plate ($I_{is}$) and a magnetic probe (db/dt). Reduction of the magnetic fluctuation is also seen after the H-mode-like transition. No clear mode numbers are observed on the ELM-like bursts from the magnetic probe measurement. This H-mode-like feature, however, disappears after turning off the second NBI at t=2.1s. It strongly suggests that a relatively narrow power window exists for keeping the H-mode-like phase.

Pressure profiles in the ergodic layer measured with YAG laser Thomson diagnostics are plotted in Fig.3. The data are obtained at t=1.225s before transition (open circles) and t=1.625s after transition (solid circles) in the same discharge shown in Fig.2. The position of ι/2π=1 surface is indicated by a vertical dashed line and the LCFS position is R=4.560m shown by a vertical solid line. The edge pressure rapidly increases near ι/2π=1 position and it is seen that a steeper pressure gradient is formed after the transition, although the edge $T_e$ decreases after the transition because of density increase.

Temporal behaviors of three chord-integrated densities from the edge region are traced in Fig.4(a)-(c). The ergodic layer becomes thick at the inboard side, then, the signals of (a) and (b) show the information only from the ergodic layer. A relatively high density exists even in the middle of the ergodic layer of R=3.399m where the $L_c$ is roughly 100m. A high density is not formed at a region of Lc<10m. Precise measurement was also done to investigate the relation between the ι/2π=1 position and the density bursts position using a multichannel $CO_2$ interferometer with a spatial resolution of 1cm. It is seen that the amplitude of the density bursts become the largest at ι/2π=1 position.

The edge rotational transform in vacuum is used at present. Taking into account the plasma pressure, the edge rotational transform profile seems to be modified, based on a modification of chaotic magnetic field structure of the ergodic layer. A detailed discussion has to be made for the modification.

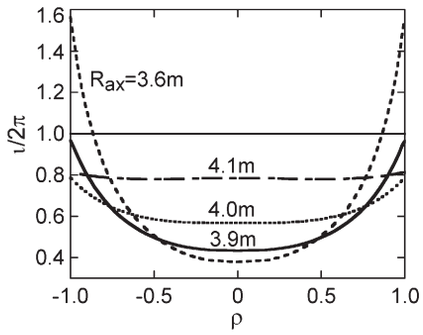


Fig. 1 Rotational transform as a parameter of $R_{ax}$.

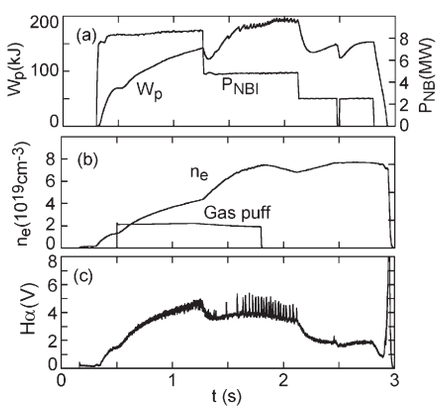


Fig. 2 H-mode-like discharge with ELM-like bursts.

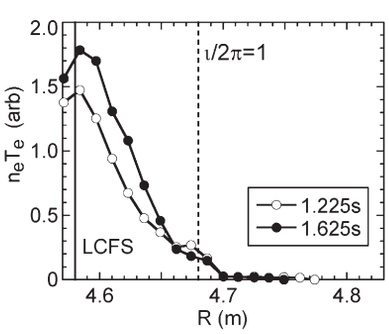


Fig. 3 Edge pressure profile before and after transition.

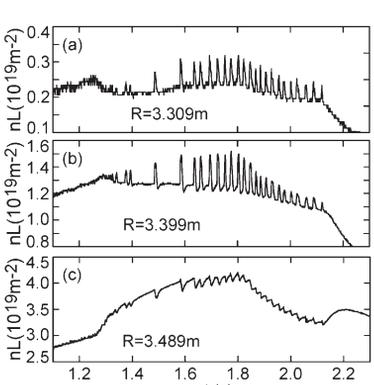


Fig. 4 Edge density behaviors during ELM-like bursts.

References

1) Morita, S. et al., PPCF **48** (2006) A269.